

## CLAIMS

1        1. A regenerative amplifier system, comprising:  
2              a pump source that produces a pump beam;  
3              first and second mirrors that define a resonant cavity  
4              a gain medium positioned in the resonant cavity and optically coupled to the  
5          pump source;  
6              an oscillator that produces multiple seed pulses;  
7              a first electro-optic switch positioned external to the cavity, the first electro-  
8          optic switch configured to provide selection of a single seed pulse for the cavity and  
9          directs an amplified pulse produced in the cavity in a direction away from the  
10         oscillator, and  
11              a second electro-optic switch positioned in the cavity that switches the seed  
12         pulse in and out of the cavity.

1        2. The system of claim 1, wherein the first and second electro-optic  
2          switches are Pockels cells.

1        3. The system of claim 1, wherein the gain media is selected from  
2          Yb:KGW, Yb:KYW, Yb:YAG, Yb:SYS, Yb:BOYS, Yb:GdCOB, Yb:glass, Nd:KGW,  
3          Nd:glass, Cr:LiSAF, Cr:LiCAF, Ti:sapphire, Nd:YAG, Nd:YLF and Nd:YVO<sub>4</sub>.

1        4. The system of claim 1, wherein the gain media is Yb:KGW.

1        5. The system of claim 1, wherein the pump beam has a power in the  
2          range of 1-100 W.

1        6. The system of claim 1, wherein the pump beam has a power in the  
2          range of 1-30 W.

1        7. The system of claim 1, wherein the pump beam has a power in the  
2          range of 1-10 W.

1        8. The system of claim 1, wherein the pump beam has a wavelength in  
2          the range of 800 to 1000 nm.

1           9.     The system of claim 1, wherein the seed pulse has a duration in the  
2 range of about 100 fs.

1           10.    The system of claim 1, wherein the seed pulse has a duration in the  
2 range of about 300 fs.

1           11.    The system of claim 1, wherein the seed pulse has a duration in the  
2 range of about 1ps.

1           12.    The system of claim 1, wherein the stretched seed pulse has a duration  
2 in the range of about 100 ps.

1           13.    The system of claim 1, wherein the stretched seed pulse has a duration  
2 in the range of about 300 ps.

1           14.    The system of claim 1, wherein the stretched seed pulse has a duration  
2 in the range of about 1ns.

1           15.    The system of claim 1, wherein the full power of the seed pulse can be  
2 switched in to the cavity.

1           16.    The system of claim 1, wherein the undesired seed pulses do not pass  
2 through the gain medium.

1           17.    The system of claim 1, wherein the pump source is selected from a  
2 diode, a diode bar, a fiber-coupled diode bar, and a single fiber-coupled diode bar.

1           18.    The system of claim 1, wherein the pump source is a single fiber-  
2 coupled diode source.

1           19.    A method for producing an amplified pulse from a regenerative  
2 amplifier system, comprising:

3           producing a pump beam from a pump source;  
4           producing multiple seed pulses from the oscillator;  
5           selecting a single seed pulse for the cavity; and  
6           excluding the undesired seed pulses from the cavity, and  
7           switching the seed pulse in and out of the cavity; and

8                   directing an amplified pulse produced in the cavity in a direction away from  
9   the oscillator.

1                 20.   The method of claim 19, wherein the regenerative amplifier system  
2   includes a cavity, gain medium, first and second electro-optic switches and an  
3   oscillator.

1                 21.   The method of claim 19, wherein selecting the single seed pulse for the  
2   cavity improves a contrast ratio of the amplified pulse to a pre-pulse.

1                 22.   The method of claim 19, wherein the first electro-optic switch is  
2   positioned external to the cavity, and the second electro-optic switch is positioned in  
3   the cavity.

1                 23.   The method of claim 22, wherein the first electro-optic switch selects  
2   the single seed pulse for the cavity.

1                 24.   The method of claim 22, wherein the second electro-optic switch  
2   switches the seed pulse in and out of the cavity.

1                 25.   The method of claim 22, wherein the first electro-optic switch directs  
2   the amplified pulse produced in the cavity in a direction away from the oscillator.

1                 26.   A method for producing an amplified pulse, comprising:  
2                   providing a regenerative amplifier system that includes a cavity, gain medium,  
3   an electro-optic switch for switching a pulse in to and out of the amplifier and an  
4   oscillator;  
5                   producing a pump beam from a pump source;  
6                   producing multiple seed pulses from the oscillator;  
7                   generating a high voltage pulse with on and off voltage edges to drive the  
8   electro-optic switch; and  
9                   synchronizing the on and off voltage edges applied to the electro-optic switch  
10   by counting pulses from the oscillator.

1                 27.   The method of claim 26, wherein synchronizing the on and off voltage  
2   edges applied to the electro-optic switch reduces jitter in the voltage edges.

1           28. The method of claim 26, wherein synchronizing the on and off voltage  
2 edges applied to the electro-optic switch increases the pre-pulse contrast ratio.

1           29. The method of claim 26, wherein synchronizing the on and off voltage  
2 edges applied to the electro-optic switch increases the post-pulse contrast ratio